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NOTES ON CONVOYING IN ICE

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NOTES ON CONVOYING IN ICE

These notes should be read in conjunction with the articles on ICE and ICE Navigation which appear in the ~~latest Supplement to~~ ARCTIC PILOT Vol. I., and with the WHITE SEA PILOT, when available.

Hydrographic Department, Admiralty, LONDON.

(H.02986/44; N.I.D.5257/44. H.C.847/44.)

I N D E X

REGULATIONS FOR SHIPS CONDUCTED THROUGH THE ICE BY ICEBREAKERS

1. Application to be conducted through the ice by an icebreaker must, if in port, be made to the harbour master or chief officer of the port, and if at sea, to the captain of the icebreaker.

2. The ship, which is to be conducted through the ice is to have, in compliance with the demands of good seamanship, a sufficient supply of coal, food, wooden shores, quick drying cement, collision mats, etc., for the passage through the ice; the ship's pumping and draining equipment must be in good order and the ship must have good radio sending and receiving equipment. The harbour master, or the captain of the icebreaker should the vessel be outside the limits of the port, has the power to refuse an application to conduct a vessel to sea or to bring one into port if it is considered that the vessel to be conducted, from the construction, build, power of engines, equipment or stowage of cargo, may be exposed to danger when in the ice, as well as if the ship is not provided with legal certificates issued by State or Classification organizations, or if the term of the latter has expired.

3. Any ship, which has to be conducted by an icebreaker through the ice, must await the icebreaker at the edge of the ice and not venture into the latter without her.

4. The time and order of progression of vessels through the ice, as also the number of vessels to be conducted at the same time, will be determined by the harbour master, when in port, and by the captain of the icebreaker, when outside the limits of the port.

5. Captains of vessels, following an icebreaker in the ice, will be subject to the orders given by the captain of the icebreaker in all matters regarding movement in the ice, and are to act in accordance with them.

6. Vessels, following an icebreaker, must not overtake one another.

7. Vessels, following an icebreaker, are at any time to be prepared to go full speed astern immediately.

8. Vessels proceeding in the ice in tow, are not to go ahead with their engines without special orders. They must be constantly ready to cast off the tow rope at the first request of the icebreaker, and also to go astern if the icebreaker stops in difficult or heavy ice.

9. Priority in conducting is given to naval vessels, passenger and mail ships, ships with cargoes, the urgency of which has been confirmed in advance by special instructions; the rest of the ships proceed in the order in which they were ready to leave port, or in which they arrived at the edge of the ice.

10. Should a vessel, following an icebreaker, receive any damage, the signal of distress must be immediately made by international code.

11. Vessels, following an icebreaker in the ice, are to be guided by the signals given below, which will be made by means of a steam whistle or siren. The signals with the exception of No. 6, if made by the icebreaker, must be repeated in succession by the conducted vessels, beginning with the nearest to the icebreaker; and in the reverse order, if made by one of the following vessels.

12. If the captain of a vessel receiving assistance from, fails to carry out the orders given by the icebreaker, the captain of the icebreaker has the right to refuse further assistance until his orders have been carried out.

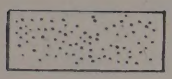
13. Neither the icebreaker, nor the owner of the icebreaker, nor the Charter-Party of the ship is responsible for damage, which may be sustained by vessels, when being assisted by an icebreaker.

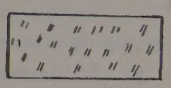
14. Merchant ships of all flags receive service, duty free, by port-icebreakers in their respective ports, for being conducted from the edge of the ice into port, or from the port out to sea, or in the port area, as well as for towing, if towing is considered necessary by the captain of the icebreaker. — The reberthing of ships due to loading or discharging operations, bunkering, taking the ship to the dock, etc., is charged for, according to the rates established for such tug-service.

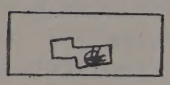
15. Any vessel making use of the services of an icebreaker for passing through the ice, by this very fact expresses consent to submit to all the stipulations of these regulations.

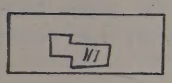
16. All regulations concerning the conducting of ships by icebreakers issued previously in any of the U.S.S.R. ports, are cancelled by the present regulations.

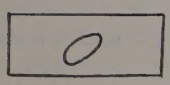
CONVENTIAL MARKINGS (SIGNS) ON RUSSIAN ICE-CHARTS.

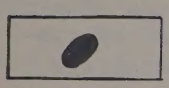
1.  Grease or slush ice

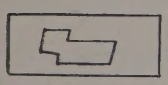
2.  Brash, sludge ice

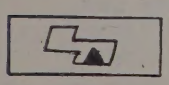
3.  Pancake ice

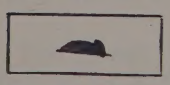
4.  Young, fresh ice

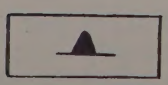
5.  Small ice

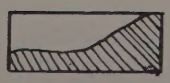
6.  Large ice

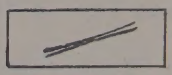
7.  Smooth ice fields and ice floes.

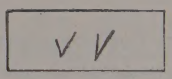
8.  Hummocky ice-fields and floes

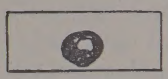
9.  Floe-bergs or hummocks aground, "Stomukhi".

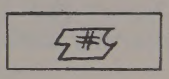
10.  Iceberg

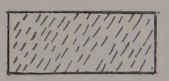
11.  Land floe

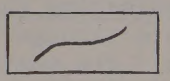
12.  Edge of ice, (Edge of clear water)

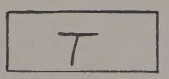
13.  Promoina, Protalina

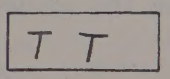
14.  Snezhnitsa on the ice

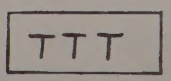
15.  Ice in the last stage of breaking up

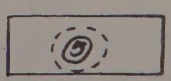
16.  Area supposed to be ice-covered.

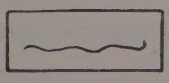
17.  The border of ice of different kinds, character & hummockiness

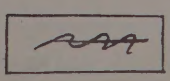
18.  Not very hummocky

19.  Hummocky.

20.  Very hummocky.

21.  The BAL (ice scale of the density of ice & border of at different thickness)

22.  Ice blink

23.  Water sky

TYPES OF SHIPS USED IN THE ARCTIC ICE

Ships used for ice navigation are divided into two main classes:-

(a) Icebreakers
(b) Vessels reinforced for ice navigation.

Class (a) is further subdivided into:-

(i) Icebreakers
(ii) Auxiliary Icebreakers
(iii) Icebreaking merchant ships.

(a) (i) The Icebreakers are designed to perform independent tactical assignments in Arctic navigation. Their dimensions are as follows:-

Length about 328 feet; Beam over 65 feet; Draft 29½ feet.
Total capacity of the three engines - up to 10,000 h.p.
Coal and water - sufficient for 30 working days.
Equipped with special pumping gear and towing facilities.

Due to their power and exceptional hull strength, these icebreakers can break the ice at speed; the bow is built to come far out on the ice, thereby enabling the icebreaker to crush it by her weight.

The large beam forces a channel broad enough for the passage of the merchant ships.

(a) (ii) Auxiliary Icebreakers accompany the icebreakers and assist in breaking the ice away from any vessels that get stuck. If the icebreaker had to return for this purpose, much time would be wasted.

(a) (iii) Icebreaking ships can navigate in ice of average thickness. Their hulls are stronger than usual, and are supplemented by ice-reinforcement. The engines are more powerful, their propellers, interchangeable with removable steel blades, and their rudders are specially designed for ice navigation.

(b) Vessels reinforced for ice navigation, have stronger hulls and more powerful engines than ordinary merchant vessels, and are able to follow the icebreakers along the channel in heavy ice.

ASSEMBLY OF CONVOY

Convoys of ships are assembled for conduct through the ice according to the ice conditions prevailing and navigational requirements.

There are three principal types of ice convoys:-

(1) Single ship convoys.
(2) One icebreaker convoying a group of ships (simple convoy).
(3) Several icebreakers convoying several ships (a composite convoy).

A simple convoy consists of several transport or other vessels and one leading icebreaker. The staff or captain of the leading icebreaker decides upon the number of vessels he can take through. It depends, first of all, on the type of ships which shall follow the icebreaker and the condition of the ice en route. If the ships to be convoyed are of the icebreaking class, with sufficiently powerful engines, an icebreaker can take an average of 4 ships through 7 - 8 bal (ice scale) ice. If the condition is favourable, i.e. 5 - 6 balov, the number of ships can be increased. If close ice (over 8 balov) is in evidence, the number of ships must be limited to 1 - 2. In conducting a large number of ships in heavy ice, it will be necessary for the icebreaker to keep returning in order to break the ships out of the ice, thus losing more time than if piloting 2 vessels.

The arrangement of the convoy should be carefully worked out. Alphabetical or any similar order is out of the question. The difference in the ice conditions in the areas along the route, and the variety of ships forming the convoy must be taken into consideration.

The first thing to be considered is the power of the ship. The weakest, as a rule, are placed immediately after the icebreaker, so that they should avoid striking ice obstacles and will move in a comparatively clear channel.

The most powerful and beamiest ships are so placed in the convoy that the less powerful vessels can proceed in their wake.

Consideration must also be given to whether a ship is loaded or in ballast, and it is essential that one of the most powerful ships in the convoy is placed in the last position in the line.

A composite convoy consists of two or three simple convoys. The number of ships to each icebreaker and their place in column is determined in the same way as that for a simple convoy. The difficulty of controlling from a position in the front is an important drawback to this type of convoy, which frequently stretches out over a distance of 1½ to 2 miles.

The first icebreaker is called the leader, the others are placed according to orders of the leader's captain, either in column or in echelon (line of bearing, "na otkol" - for breaking out).

The following methods are employed:-

During the simultaneous work of several icebreakers, the most powerful leads the convoy, breaking a channel in the ice and without stopping to break out other ships.

A composite convoy in column following an icebreaker.

In the above diagram the icebreaker-leader is first. Following her at a distance decided upon by the leader's captain are 2 - 3 ships, the weakest and beamiest in the entire convoy; the second icebreaker proceeds astern of the first group followed by 2 - 3 ships, etc.

The assignment of the second icebreaker is to break out the ships ahead of her so that the leader should not have to return to them and thus detain the convoy. The second icebreaker, on receiving a signal "stuck" from any of the preceding ships, increases speed, leaves the column and breaks out the ship.

When the latter is freed and moving, the icebreaker resumes her previous position in column.

The same action is taken by the second icebreaker upon hearing the same signal from one of the ships astern, providing there are no more icebreakers in the convoy.

If there is a third icebreaker, she breaks out the ships following the second icebreaker.

Ships must be broken out while proceeding, in order not to delay the progress of the entire convoy.

Column for breaking out (echelon, or line of bearing.)

When several icebreakers are present, in column "for breaking out", they follow behind the leader at a set distance, on the lee side; in such a way that they thin out the ice in the channel made by the leader, and are always in readiness for breaking out or towing any ship that gets stuck or that is lagging behind. (See above diagram.)

DISTANCE APART IN CONVOY

Prior to taking the ships into the ice, the captains of all ships must be carefully instructed as to the order in which they are to follow the icebreaker.

They must understand the importance of maintaining the distances between the ships and the icebreakers, as well as the distance between ships, ordered by the leader, while moving in ice. Accurate station keeping is important for the safe and speedy progress of the convoy.

If the condition of the ice is not too bad, i.e., less than 7 balov (ice scale), the ships can follow the icebreaker without much difficulty. The beaminess of the latter makes it especially so for the ships closest to her, but the channel narrows further astern, and the ships at the end of the convoy encounter greater difficulties than those in the van. It is therefore unwise to have the convoy strung out in too long a line. At the same time, the distance between ships should be large enough for way to be checked, and collision avoided, if a "STOP" signal is made by the icebreaker. As a rule, way can be checked in clear water by going astern over a distance of 3 to 3½ ship's lengths, and this distance should therefore be the minimum between ships when navigating in ice less than 7 balov. At the same time, it should be fully appreciated that this distance should not be increased for the reason given at the beginning of this paragraph, and especially if the speed of advance of the whole convoy is not to be reduced.

The channel made by the icebreaker is quickly filled with broken ice. The pressure exerted by this ice on a ship in a narrow channel naturally increases when the distance between ships is increased, and even powerful ships find their speed greatly reduced. This is another argument for maintaining the minimum prescribed distance apart.

A sharp lookout must be kept for signals from the leading icebreaker and these must be executed promptly and correctly. The ships ahead and astern, as well as the condition of the ice, must be carefully watched.

When navigating in close (thicker) ice, the distances suggested above, must be decreased, and in order to avoid damage from the ice floating in the channel, the engines must work slowly, and the ship must carry little headway. If the ice reaches 10 balov (ice scale), and it is under considerable pressure, the distance must be reduced to a few metres.

Under these conditions the channel would be quickly covered with ice, leaving only a small lead astern of the icebreaker, narrower than the beam of the vessel. If a ship should follow at a distance of 2 - 3 ship-lengths from the icebreaker, the influence of the icebreaker would hardly be noticed. The vessel would either stop or become stuck in the ice.

Piloting a ship at reduced distances requires a certain amount of experience from both the icebreaker's staff and the officers of piloted vessels. It often happens that in heavy ice, there are obstacles which the icebreaker cannot overcome on the run, she suddenly stops and gives the signal "full astern" to the following ships. In order to avoid collision, the ships must go astern immediately.

When moving in such close formation, the thickness of the ice ahead must be carefully observed by the icebreaker's staff so that probable fluctuations in speed can be anticipated, and the necessary warning passed to the ships astern in plenty of time. The danger resulting from a sudden stop on the part of the icebreaker, is obvious.

The importance of maintaining the correct distance applicable to the ice conditions is therefore clear. This distance can never be greater than 3 to $3\frac{1}{2}$ ship-lengths, and is usually a matter of a few yards only. The distances must be changed with the varying condition of the ice, and the greatest attention must be given to accurate station keeping. When navigating in ice, the slightest lack of attention or disregard of ice navigation rules, can result in very serious consequences.

On the grounds of his experience and position in the convoy (which enables him to assess as well as sample the ice conditions ahead) the captain of the leading icebreaker, must estimate the distances apart to be maintained by the ships. He must signal any changes required due to altered ice conditions, etc.

It is absolutely necessary that the officers of the piloted ships should be thoroughly acquainted with all the signals used during navigation in ice, and should realise the importance of their prompt repetition, as well as obedience. On no account should it be necessary for the icebreaker to repeat a signal, due to slackness in the execution of that particular order. A ship is not allowed to act as an independent unit, and in this respect ice navigation is totally different from that in the open sea. The orders of the leading icebreaker must be obeyed implicitly.

SPEED OF CONVOY

In a convoy composed of vessels of the icebreaking type, the following speeds can be attained in ice of various thickness and density. If the route lies through small floe ice of about 5 balov (ice scale), with leads of clear water, the speed of 6 - 7 knots can be maintained; but only if the captain of the leading icebreaker is certain that the ships following him will not collide with the ice floes (floating ice floes).

It must be remembered that collision with even a small ice floe will damage the hulls of ships of the ordinary type.

Also that the ice on the surface thaws under the sun's rays and is washed away, whereas the underwater part lasts much longer; thus forming underwater projections (spits) of ice, protruding for several metres.

Ships following the icebreaker must, therefore, be alive to the danger of passing close to the floes.

If a vessel manoeuvring in ice cannot keep off the floe, the icebreaker should be asked by signal to widen the channel.

The speed and success of navigation depends, first of all, on the structure and density of the ice, and secondly, on the type of vessel. An icebreaker can move in navigable ice with greater speed than an icebreaking ship; the latter moves faster than a ship reinforced for icebreaking; ordinary merchant ships move slower than those reinforced for icebreaking.

The speed of the convoy must be decided upon by the captain of the leading icebreaker.

When navigating in small ice and ice floes with fields of 7 - 8 balov, the speed must not exceed 4 - 5 knots. In such ice, the convoy follows the channel, which does not remain open long after the passage of the icebreaker; therefore, the distance must be decreased to $1\frac{1}{2}$ - 2 ship-lengths to enable the ships to move in as clear a channel as possible. Faster speeds in this case not only increase the danger of hitting the ice, but also the possibility of colliding during sudden stops of the icebreaker, or of those of the ships in the convoy. In the channel itself, danger from underwater ice projections somewhat decreases as these are destroyed by the icebreaker, but this danger reappears on entry into areas of thin ice.

If the signal "full astern" has to be given without warning, while passing through an ice covered channel, the stern will kick to port and the bow to starboard, if the ship is single screw. This will probably cause damage to the propeller, rudder and starboard side of the ship.

When small ice closes up to 9 - 10 balov (ice scale), providing the ice is not under pressure and passage in it is possible, the convoy moves only along the channel broken by the icebreaker. The speed then is decreased to 1 - 2 knots. If there are large floes (floe ice) and fields, the icebreaker must force the field and return more or less frequently to break out the ships. Therefore, the speed may decrease to less than a knot.

COURSE OF CONVOY

Before entering the ice, the icebreaker captains and masters of piloted ships must clearly visualize the condition of the ice in the various sectors along the prospective route.

Ice charts, based on the air reconnaissance observations from stations in the Arctic area, are prepared, for this purpose, and statistics of winds and currents in these sections, supplied. (For abbreviations used on Russian Ice charts, see page 5).

The track to be maintained is decided upon by the operating staff or captain of the leading icebreaker, as the case may be, after a careful study of the ice charts and the synoptic forecast, as well as the coastal outline, depths along the route, areas of permanent ice-pressure, etc. The longest route in clear water is shorter than the more direct one in ice, and the selected track should pass through areas of thin ice or in clear water, regardless of the length of the voyage, provided the depths along the route are adequate.

Consideration must also be given to the assistance which may be forthcoming from the prevailing wind and current. In some areas, even in heavy ice, such help is pronounced. At the approaches to Vilkitsky Strait, from the Kara Sea, ships can drift past Cape Chelynskin, even in 10 bal ice. In this area westerly winds set up strong north-easterly currents, which carry the ice through Vilkitsky Strait; but with strong north-westerly winds the ships will be subjected to considerable pressure.

CONDUCTING (PILOTING) THROUGH THE ICE

In following the icebreaker, a convoy must keep dead astern of her. If the icebreaker alters course, all ships must turn, in succession, to the new course. By looking for independent channels, the ships break up the convoy and usually get stuck; this, as a rule, compels the icebreaker to return and break out each ship separately, thereby delaying the whole convoy.

In small ice and floe ice with fields, the condition of the ice is constantly changing. Passage through the former is easy, but in floes and field ice, it is difficult. To overcome them, the icebreaker increases her speed, and by striking the ice, crushes or breaks it ahead of her. The ships astern must then watch their distances carefully and try to enter the channel made by the icebreaker before it closes again.

The captain of the leading icebreaker must study the ice ahead very carefully. If the icebreaker should encounter a solid ice-obstacle, and a glancing blow is struck by the stem, she will be thrown back and sideways to the direction of least resistance. The ships following close astern will be unable to make such a quick turn and will receive damage through striking the heavy ice. This is particularly so in the case of single screw ships. This zig-zagging must be expected when proceeding through ice of various structure and strength.

Under such circumstances, the icebreaker should not make too rapid a return to the original course, so as to avoid aggravating the zig-zag.

The character of the ice can usually be determined by its outward appearance.

Winter ice is almost always covered with snow, and, at first, all winter ice seems exactly the same, but an experienced eye can detect obstacles. Sometimes there are snowdrifts to be noticed on the ice. This indicates the presence of concealed hummocks. This ice will be more difficult to overcome, not only for the icebreaker, but for the entire convoy, and though the ice is seemingly even, the route must be chosen so as to avoid this hummocky ice. The absence of hummocks and unevenness, in general, is the only sign of passable ice in winter.

When it is necessary to pass through ranges of hummocky ice, which cannot be outflanked, the shortest route must be chosen; the hummocks must be crushed in a direction at right angles to the range.

If, however, the hummocks have cracks, at an angle to the general line of the range, the cracks should be followed.

If navigable, it is much easier to maintain the course in close ice than in floe ice or in ice with large fields.

Generally speaking, in close ice an icebreaker runs smoother and can be controlled better by using the rudder with a little assistance from the engines. In close floe ice or in close ice with fields, the icebreaker does not answer the rudder well, and the ship must be steered with the help of the out-board engines.

In summer there are very many signs indicating the passability of the ice. The principal ones are:- (a) whether the ice has been softened by the sun, or if it still retains its winter hardness, and (b) the number of hummocks en route. Experienced icebreaker captains and ice pilots consider that ice of greenish, or greenish-blue colour is the hardest to crush. Such ice should be out-flanked. This type of ice is sometimes covered with "Snezhnitsa" (pools of clear water formed during the thaw of snow on the surface of the ice). There are also "Protalina" (oval holes, caused by the water trickling down the ice after the snow has thawed), in this type of ice. If there are a considerable number of these holes on a field of greenish-blue ice, the field will be weakened,

and the ice can be forced. It will not be necessary to break the entire field, but only the arches between the holes.

The condition, as well as the colour of the ice, must be considered and an occasional test at slow speed by the icebreaker is well worth while.

If sections of dirty looking ice occur in areas of light coloured ice, the former should provide the easier route, since the darker object collects more sun, and melts the sooner. Even thick floes of dark ice are found to be spongy inside, and their compactness much less than that of the surrounding ice. On impact with the icebreaker's bow, it will crack in spite of its thickness.

The most passable ice is considered to be small ice, even though the density of it equals 10 balov (ice scale). This ice usually closes up due to action of tides and winds, but consists of separate floes and therefore does not present a serious obstacle for the passage of the icebreaker or the conducted ships. However, when the pressure is great, an icebreaker will get through, but the ships astern are usually hindered, as the channel behind the icebreaker closes up immediately.

The question, whether it is worth while proceeding in such small 10 bal ice under pressure, or if it is better to choose a different route, can be answered only on the spot after considering the character and direction of the pressure as well as other factors. It must be remembered, that in small and mush-ice, even during pressure, the ships are in less danger, than if they are being pressed in floe ice and between fields.

When many hummocks are encountered the icebreaker must first attempt to outflank them. If this is impossible the icebreaker may even choose a route in the heavy ice which at first seems impassable. The outward characteristics of the hummocky ice indicate to what extent it is navigable. If the hummocks consist of large blocks not melted together into one solid piece, they are easily destroyed; if the hummocks consist of large blocks of ice many metres thick, they are impassable to an icebreaker.

For ice navigation the axiom that "The straight line is the shortest distance between two points" is not true. Ships must often be taken along courses unrelated to the general route of the ship. For example:- if there is a section of difficult or impassable ice dead ahead, while at the same time the information given by ice and synoptic charts, plus the information of the ice reconnaissance show that better conditions are found either to port or starboard of the course, it is clear that in such a case it is necessary to deviate until the section of easier ice is reached, and then afterwards return to the original course.

Sometimes, cracks and narrow leads at right angles to the course of the convoy are encountered. If the bridges (arches) between the leads are very heavy and wide, it is better to follow the crack and seek easier ones than to attempt to break the heavy bridges and proceed direct into the next lead. In this case the convoy is often lead on a directly opposite course. And yet, while going from lead to lead, the convoy proceeds in the required, or general direction.

In passing through zones of closed ice, there are places where an icebreaker cannot pass. The great amount of friction created by the ice against the icebreaker's sides hinders her advance and she stops. The power of the engines in these cases is insufficient and the ship gradually loses way.

Such ice can be broken only by forcing it, i.e. by making a channel as a result of striking the ice. It is done in the following way:-

From the thickness and compactness of the ice, the captain of the icebreaker determines the distance from which he must start the icebreaker in order to attain sufficient inertia required for the initial blow. The inertia must be added to the power of the engines, since they alone cannot overcome the obstacle. Usually they back up a distance of from 1 to 3 hull lengths, then go full speed ahead until the icebreaker pushes its stem onto the ice. It must be remembered that the ice must be struck only by the stem and not by the turn of the bow; in the latter case, the ship's hull might be damaged. If the icebreaker manages to break through the bridge at once, the convoy proceeds along the course; but the ice cannot be forced as easily as that in every case, and if the obstacle is strong and extends a great distance, the blow must be repeated for many hours in succession.

If the bridge has not been broken after one blow, the icebreaker upon losing its inertia stops. The captain must keep a sharp lookout for this since as soon as the icebreaker slackens speed, the engines should immediately be reversed to full speed astern. If this moment is lost and the icebreaker stops in the ice while the engines are going full speed ahead, the ship will invariably wedge in, and a lot of time lost in releasing her. When the engines are going astern, the rudder must be amidships. Once clear, the icebreaker backs the required distance, and repeats the blow.

It might be necessary to make either a simple channel, equal to the width of the beam of the icebreaker, or a double or triple one, depending on the strength and character of the ice.

After making a channel, the icebreaker returns to the ships; if the channel remains open, the icebreaker will be able to lead 2 - 3 ships at a time. If there is a lot of ice in the channel and several ships cannot pass unescorted, the ships are taken through the ice one by one.

If the condition of the ice gets worse en route, and a convoy of 3 - 4 ships becomes too large, the assistance afforded by the icebreaker will be lost on the rearmost ships, which will have to be broken out continuously. If, in such circumstances, a radical and rapid change in the weather conditions, or in the condition of the ice, is expected, it is better to wait for the improvement and then proceed with the whole convoy. If, however, such a change is not anticipated, the ships must be conducted a certain distance ahead one by one, which results in the speedier advance of all the ships.

In this case precautions must be taken to prevent the ships left behind from damage caused by the ice. Sludge-ice (ice broken into small pieces) consists of a more or less homogeneous mass. If being pressed against the ship, it creates a kind of cushion, and the ship experiences equal pressure along the entire length. If the ship is in the proximity of large floes, floe ice or ice fields, the pressure may result in serious damage, and perhaps the loss of the ship.

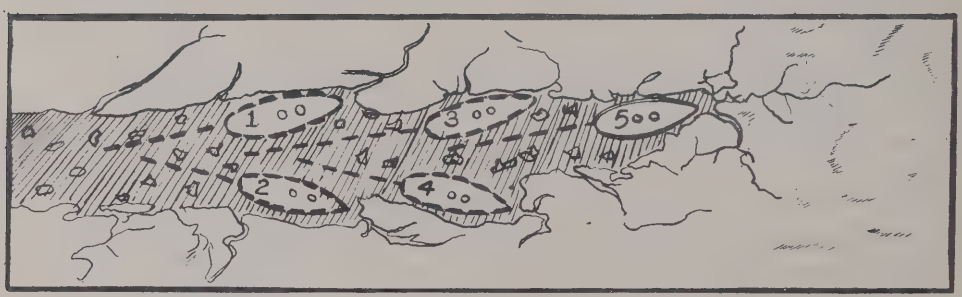
Heavy ice, when under pressure, creates a strain at certain points, or over certain sections, of the hull. Forced by the closing ice, the large blocks of ice in the channel may be crushed against the hull, and cause indentations or may even penetrate the ship's side.

Under these circumstances, the icebreaker must make a few trips round the ships, so as to break the large floes, and then take the ships on one by one, without fear that those left in the ice will be damaged or crushed.

CONDUCTING IN EXCEPTIONALLY HEAVY (WINTER) ICE

The most difficult work for an icebreaker is to conduct (pilot) ships in the motionless winter ice, with no leads or cracks. The broken ice remains in the channel with the exception of a small amount which goes under its edge. If the channel is to be of considerable length, a lot of mush ice hinders not only the convoyed ships, but also makes the progress of the icebreaker more difficult. Even if small, hummocky ranges are encountered, the icebreaker often wedges in, and to avoid wedging and to facilitate the movement of the ships and manoeuvring, it is necessary to break a channel considerably wider than the beam of the icebreaker.

Under such circumstances, the width of the channel must be sufficient for an icebreaker to turn, i.e. 100 - 120 metres (328 - 394 feet). To achieve this, a double or triple channel is broken. The double channel is made by the "yolochka" or "fir tree method". (See diagram below).



Breaking a double channel by the "yolochka" method.

To break a channel by this method, the icebreaker strikes the ice, firstly at a small angle to port; backs up; and strikes again at an angle to starboard of the course, and so on; thus alternating the direction of the blows. Breaking the ice in such a way leaves the greater part of the icebreaker free, since only the stem hits the ice, the hull, from amidships to the stern, is in clear water, thus preventing it from being wedged in.

If, due to local conditions, a double channel is too narrow, a triple one is made. The same method, though a bit more complicated, is used. (See diagram below).

Breaking a triple channel by complicated "yolechka" method.

One blow is made to port, but at a greater angle than for a double channel. The second blow to starboard is also at a greater angle. The third blow is directed against the spit or tongue of ice which protrudes in the middle. In this way the triple channel is broken.

The time taken to break a channel in winter ice of 120 - 130 cm. (47 to 51 inches) thickness is considerable, and it has required 40 working hours, on occasion, to break a 7 mile channel in such ice.

Explosives are used as an auxiliary means for getting the icebreaker through difficult obstacles.

The heretofore accepted opinion that channels of various lengths could be made by using explosives has been proved to be impractical. Nevertheless, a sufficient supply of dynamite should always be carried by the icebreaker, to destroy bridges (arches) separating one lead from the other, and which cannot be otherwise forced by the icebreaker.

Before placing a charge, one of the ship's officers must examine the ice for a spot which would offer the least resistance. The explosion creates cracks in the main part of the ice-bridge (arch) which weakens the ice sufficiently to facilitate breaking by the icebreaker.

When forcing heavy fields en route, the icebreaker sometimes encounters very heavy (strong) hummocky ranges, stretching a great distance. In such cases explosives can also be of help. The hummock must be examined before placing the charge so that the maximum effect is obtained from the explosion. Even if cracks fail to appear, the ice-bridges (arches) between the frozen hummocks or floes comprising the range will nevertheless be weakened.

After firing the charge the icebreaker must immediately go forward onto the ice following up the advantage created by the explosion.

TOWING IN ICE

When piloting merchant vessels in close ice of medium thickness, it is sometimes necessary to take them in tow on account of ice pressure, engine, propeller, rudder, damage, etc.

All icebreakers are provided with necessary towing equipment. The latter consists of a tow winch and tow rope reeled on the winch drum; the end of the tow rope is provided with a large strap which is lead through a specially constructed block at the stern indentation.

In thin open ice, the ship is towed by the icebreaker using a long tow-line. In this case, the entire tow rope is eased off, with the exception of a few turns. Such towing is used when the ship has been damaged and cannot proceed under her own power in clear water, or when the ship's engines are not powerful enough to enable the ship to move even in comparatively thin or open ice.

When navigating in heavier floe ice, with moderate pressure, a short tow is used if the piloted ship cannot make headway unassisted. In this case the tow rope is eased off to 10 - 15 metres (33 to 49 feet) and the vessel will advance in the icebreaker's wake, where the propeller wash prevents the ice from closing up immediately.

If the icebreaker slows down, the towed ship, which is being held back by compact ice, has enough time to go astern, provided the signals for reducing speed and going astern are given by the icebreaker in sufficient time. If the icebreaker stops unexpectedly, when using the short tow, collision and damage are almost inevitable, and the captain of the towed vessel must be fully alive to, and prepared for, such an eventuality.

Icebreakers with a stern indentation use this method of towing only in exceptional circumstances, and when the shape of the piloted ship's stern is not adapted for close towing.

If collision between the icebreaker and the tow is unavoidable, the former should go "full ahead" on her engines, in the hope that her wash will throw the towed vessel's bow to one side, and make the blow a glancing one instead of a direct bow to stern collision. This action is recommended in all cases (even when not towing) when the ship astern creeps up to the icebreaker.

When the ice pressure is great, the channel closes up immediately astern of the icebreaker, and in such circumstances, it is necessary to tow the ship close under the icebreaker's stern. To do this the stem of the towed vessel is secured as close as possible to the indentation at the icebreaker's stern, by means of the tow rope. The winch, backed by additional stoppers, is secured so that the tow cannot ease off. The icebreaker and the tow move as one unit, and advance is possible in the heaviest ice, as long as the icebreaker can use her engines. The control of the icebreaker is, however, more difficult as the towed vessel tends to act as an uncontrollable rudder. When the icebreaker stops, it is almost impossible to drop astern, as the towed vessel's rudder will be endangered.

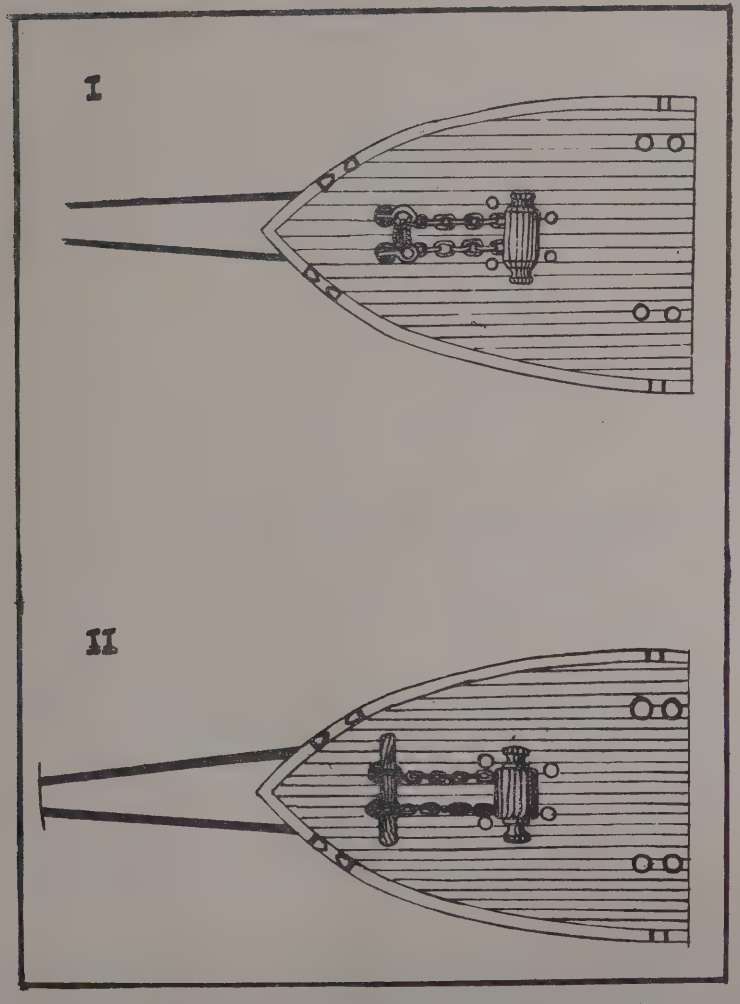
Towing arrangements in all merchant ships must be examined, and in a full state of efficiency and readiness before the convoy sails.

Just before entering the ice the ship's anchors must be secured on deck, firstly to prevent the anchors from hitting the ice while passing hummocks, and thereby damaging the hawse pipes, secondly - to enable the ship to take the tow lines from the icebreaker through the hawse pipes at any time.

The ship's officers must know how to take a heavy tow line as quickly as possible, and to secure it so that it can be slipped with the minimum delay, when signalled to do so by the icebreaker.

Wire rope messengers must be led through the hawse pipes in advance. The straps of the icebreaker's tow lines are secured to these. The wire rope messengers are then brought to the winch and the straps of the tow lines hauled up on deck, and secured.

Diagram No. I, shows one method of securing the tow lines in the towed ship. A manila or hemp line is passed through the two straps, the two tow lines being thus secured on deck by several turns of the manila or hemp line. When ordered to slip the tow, the turns of manila or hemp are cut, and the two straps released. The disadvantage of this method is the rapidity with which the manila or hemp wears out, resulting in the parting of the tow.



Methods of securing the strap :(I) with a Manila rope; (II) by securing the strap to the beam.

Therefore, when towing in very heavy ice, where jerking is unavoidable, the best thing to do is to secure the straps to a wooden beam. (See diagram No. II). When the straps are brought up on deck through the hawse pipes the beam is passed through both eyes. In order to cast off, if secured in this manner, the straps are eased up, the beam is pushed out of the eyes and the tow rope is cast off. If soft wood (aspen) is used for securing, or several layers of planks, during the stretching of the tow rope the wood is deformed, and the tow line eats into it. In this case when casting off, it is necessary to cut the wood until the ends are free.

A large slip can be used for joining the eyes of the two tow lines, but if incorrectly secured it may get twisted and deformed, making a quick release difficult.

There are other methods of securing the tow lines, but on no account must the tow straps be made fast to the bitts. The latter will invariably break, as they are not strong enough to take the great strain exerted when towing a vessel through ice.

RESPONSIBILITY WHILE TOWING SHIPS

Paragraph 305. Responsibility while towing ships, rests with:

(a) When using the service of port tugs for bringing a ship in or taking her out of port, as well as when shifting from one berth to another within the limits of the port - the captain of the towed vessel, whether the ship's engines are running or not.

(b) If the ship is towed outside of the port area - with the captain of the tug, if no other agreement has been made.

(c) When towing the ship through the ice - with the captain of the icebreaker.

All instructions of the master of the ship, conducting the towing according to this paragraph, are to be promptly executed by the other ship or ships.

(Excerpt from "Regulations of Technical Exploitation of the Sea Transport of the U.S.S.R." Issued by the People's Commissariat for Water Transport, 1937.)

THE BREAKING OUT OF SHIPS

If a ship fails to make headway in the ice, she must make the following signal, by siren or steam whistle, without delay:-

"I am stuck in the ice".

Upon receiving the signal, and if conditions permit, the icebreaker signals the other ships to proceed on the course without her, and then she returns to, and breaks out, the icebound ship.

Ships are broken out of the ice in various ways, the method adopted depending on the condition of the ice.

If the ship is stuck in comparatively easy ice, the icebreaker, to save time, goes astern, without turning, keeping her bow on the original course, and passes the ship close to one side. After coming alongside, the icebreaker backs as far as the stern and then goes ahead, simultaneously signalling the ship to follow. If this manoeuvre is performed at a distance of from 5 to 10 metres (16.4 to 32.8 feet) from the ship's side, the vessel, as a rule, can follow the channel, as the ice astern of the icebreaker is considerably thinned out.

The direction of the wind must be carefully noted, and for breaking out the lee side is chosen. If the icebreaker approaches to windward, the ship is blown towards the unbroken ice, and even after being broken out, she will be unable to move. When the icebreaker comes up on the lee side, a certain weakening is observed, even in heavy ice, and the ship is pushed by the wind in that direction. The friction of the ice on the sides becomes less, and by using her engines the ship can follow the icebreaker.

During calm and light winds, and with head winds and winds from aft, the ship must be broken out from the side on which there are fewer ice obstacles. This enables the icebreaker to complete the operation in a shorter time. The presence of the weak places facilitates the breaking of the channel and also assists the ice in moving away.

The above applies when the icebreaker breaks out a ship with her stern. In heavy ice conditions this method is not practical for the following reasons:- When going astern the ice is piled up under the counter and fouls the propellers, with chunks getting between the blades; this may cause the engines, which are rotating at full speed, to stop suddenly. The same thing happens when the propeller gets caught against a chunk of ice, which in turn presses other projections of the ice floe. The propeller is unable to overcome this obstacle, which may break a blade or cause the loss of the entire propeller. Going astern in heavy ice may also disable the icebreaker's rudder.

Therefore, the above method of breaking out ships should only be employed when there is no danger of damage to the propellers, rudder, or, when there is no other solution.

Ships can also be broken out by the icebreaker making complete bow turns. This takes a great deal of time as the icebreaker first turns toward the ship and then makes another turn astern of the ship. On making the turn toward the ship, the icebreaker approaches her on the lee side and passes along her close aboard. Astern of the ship the icebreaker turns again to the original course. Moving ahead the second time along the ship's side thinning out the ice, she at the same time signals the ship to follow.

The heavier the ice, the more time is required by this method. But in exceptionally heavy ice this is the only suitable one.

Sometimes the vessels get stuck on fields of such heavy ice, that the icebreaker cannot reach them. In such cases, before releasing the ship, the icebreaker is compelled to force the entire ice-field on one side or the other. By thus thinning the field, and by forcing it, the icebreaker eventually breaks out the ship, and enables her to proceed. The same method is used in large floe ice with fields. When such a field is freed, for some reason or other, there is a great unrelated grinding movement of the field, called "ice slants" (lyod kosit), by icebreaking people. Such ice should be avoided at all costs, because a ship stuck between the fields may damage her hull before the icebreaker can break her out.

It is sometimes necessary to break the ice round the same ship several times before she is freed. This usually occurs during ice pressure, or if the ship's engines are very low powered.

The above methods of breaking out single ships are the principal ones, but when breaking out a ship, it should be remembered that the other ships, left without assistance, are usually blocked by the ice, and are unable to proceed on their own.

When the ships are in column, the icebreaker passes the entire convoy on the lee side and, at the greatest possible speed, proceeds along the course of the convoy, breaking it out entirely. The ships then proceed along the channel broken by the icebreaker. This manoeuvre is usually made by the turning method, and is only used in extraordinary circumstances, if the ship is to be broken out with the icebreaker's stern.

While breaking out a ship, the ice often cracks towards the ship's sides. If the icebreaker passes her at a great speed the icebreaker's bow turns along the crack towards the ship. This should be carefully guarded against, and immediate action taken to counter it if necessary, otherwise collision, with resulting damage, is probable.

In general, when passing close to a ship, an estimate of the character of the ice between the icebreaker and the ship must be accurately made. If there is weak ice close to the ship, the icebreaker may be thrown against the latter. Likewise, when breaking a ship out, the strength of her hull most also be taken into consideration, since while passing close aboard the ship, the icebreaker with her great force presses the ice against the ship's sides, and in consequence, the speed of the icebreaker must be regulated accordingly.

SIGNALS USED WHILE CONDUCTING SHIPS THROUGH ICE

No. of signal	From the leading icebreaker	From the conducted vessel
(1) - - .	Am going ahead, follow me.	Am going ahead, follow the icebreaker.
(2) - .	Reduce your speed.	Am reducing my speed.
(3) . . .	Go full speed astern.	Am going full speed astern.
(4) - -	Do not follow me, stop where you are.	Am stopping where I am.
(5)	Stuck in the ice, attention.	Stuck in the ice, attention.
(6) - . -	Prepare to take towrope.	Am prepared to take towrope.
	If the vessel is already in tow:	
	Cast off the towrope.	The towrope is cast off.
(7) - . - .	Go ahead, follow the channel.	I am going ahead, following the channel.
(8) . - - -	Shorten the interval.	I am shortening the interval.
(9) - - -	Proceed on your voyage.	I am proceeding to my destination.
(10) . - .	Pay attention to the radio, or, listen to the radio.	I am paying attention to the radio, or, I am listening to the radio.
(11) - . . -	Attention; look out for the signal.	Attention; I am looking out for the signal.
(12) . - - .	Anchor.	I am anchoring.
(13) - - - - -	Work stopped until morning or until more favourable circumstances. If made while work is stopped, signifies:	
	Get ready.	I am getting ready.

NOTE: The signals (siren or steam whistle) when scattered in the ice are the same as Rules for Preventing Collisions at Sea.

One short blast - "Am going to starboard"
Two short blasts - "Am going to port"
Three short blasts - "The engines are going astern"

2. The leading icebreaker is the one ahead of a single ship or several ships.

3. A dash signifies a long blast, a dot - a short blast.

4. During the work of several icebreakers at the same time, the senior is the one whose engines are most powerful, and his orders are to be executed by the other icebreakers, if no other orders have been issued by the respective harbour master.

THE ICE SCALE

An arbitrary scale for estimating the density (compactness) of ice is used. It ranges from 1 to 10 and is called BAL (singular), BALS or BALOV (plural).

In order to estimate the thickness of ice, it is necessary first, to find out the kind of ice prevalent in the area, determining, extent of ice floes and leads between them. Afterwards it is necessary to calculate to what extent the area is ice covered and if it is larger or smaller than the area of water. If the area covered with ice EQUALS that which is covered with water - the thickness is 5 BALOV (ice scale) (50 - 50).

A little more	-	6 BALOV	Twice as little	-	3 BALA
A little less	-	4 BALA	4 times as much	-	8 BALOV
Twice as much	-	7 BALOV	4 times less	-	2 BALA

If the ice is almost unbroken - its thickness is 9 BALOV (ice scale), if completely unbroken - 10 BALOV.

If a few separate pieces of ice are seen, which occupy not more than 1/10 of the sea-surface - the thickness of ice is 1 BAL (ice scale).

Navigation is more difficult in field-ice than in small-ice or floe-ice. The density (compactness) and thickness of ice determines the extent of navigation in the ice.

WHITE SEA ICE TERMS

KOLOBI and OSTROGI - The area of the sea where the ice during any tidal phase is always unbroken.

RAZDELY - The reverse of the above ice-condition.

SNEZHNITSA - Pools of clear water, which are formed during the thaw of snow on the surface of the ice.

PROTALINA - Is an oval hole in the ice, caused by the water trickling down the ice from the thawing snow.

PROMOINA - Is a long hole in the ice formed in Spring or Summer, occuring in places of strong tidal streams from thawing ice.

VODYANOI ZABEREG - Is an accumulation of water over the ice, close to the shore.

SKVOZNOI VODYANOI ZABEREG - A hole in the land-floe very close to the shore and parallel to it.

EDGE OF ICE (KROMKA LDA) - Border (indicated by a dotted line on the ice-chart), between ice and clear water.

G L O S S A R Y

AVARIYA	Damage
BALLER RULYA	Stock-head; rudder stock
BORTOVIYE MASHINI	Outboard engines
BORTOVIYE VINTI	Outboard screws
BRASHPIL	Windlass
DIFFERENTOVANIYE	Interchanging draft of ship aft and for'd
DIFFERENTNIYE TSISTERNI	Tanks for changing draft aft and for'd
DONNI LAG	Bottom log
DREIF	Drift
DVIGATEL, MASHINA	Engine
FORSHTEVEN	Stem
GLIBA LDA	Block, chunk of ice
GLUBOKO SIDYASHCHI LYOD	Deeply submerged ice
GRUZ	Cargo
GRUZOVIYE LEBYODKI	Cargo-gear, winches
GRYADA TOROSOV	Hummocky range, range of hummocks
ICEBEAMS	Special inside reinforcement for ships while navigating in ice
KASHEOBRAZNI LYOD	Mush-like ice
KORMOVOI BUKSIRNI VIREZ	Stern indentation (for towing, on icebreakers)
KORPUS	Hull
KRENOVANIYE	Listing of ships
KRENOVIYE TSISTERNI	Listing tanks
LDINKI	Very small pieces of ice
LDI TOROSYATSYA	Ice piles up in hummocks
LDI ZIMNYEVO POKROVA	Winter ice strata
LEDYANAYA KASHA	Mush-ice
LEDOVAYA OBSTANOVKA	Ice-condition
LEDOKOLNI FLOT	Icebreaking fleet
LEDOVI POYAS	Ice-belt; a protective sheathing on the under-water part of the icebreaker's hull
LEDOVI YAZIK	Underwater spit (tongue), projection of ice
LEDOKOLSHCHIKI	Ice-captains, pilots and all those working on the icebreakers & in the Arctic Sea-Route
LYOD KOSIT	Unrelated grinding motion of the ice floes or fields
LOPAST	Blade
MASSIVI	Huge hummocks, large areas of heavy ice
MNOGOLETNI LYOD	Ice which has weathered many seasons; old ice
MOSHCHNI LYOD	Very heavy, thick ice
MOSHCHNIYE TOROSISTIYE PREPYATSTVIYA	Heavy hummocky obstacles
MELKO-KRUPNOBITI LYOD	Small and large ice floes
MORISTEYE	To seawards

NAVAL LDA	Piling up of ice
"NA POPA"	A block of ice standing upright close to a ship
NEPODVIZHNI LYOD	Motionless ice
NOSOVOI VINT	Bow propeller, screw
NETOROSHENNY LYOD	More or less smooth ice with few, or no hummocks
OGON	Eye (rope)
OBSHIVKA	Plating, sheathing
OKOLKA, OKALIVAT	Breaking out, to break out
OKOLKA KORMOI	Breaking out ships with the stern of the ice-breaker
PLASTIR	Collision mats
PODSOV, TARAN	Underwater projection of ice; (lit. - "ram")
POLNI VPERYOD	"Full ahead"
POLNI NAZAD	"Full astern"
PROVODKA	Escorting, conducting ships in the ice
PRYAMO RULYA	Rudder amidships
PODTOVARNIKI	Shores
PERAMICHKA	Ice-bridge or arch between leads
RAZVOROT	Turn (manoeuvre of ship)
RAZVODYA	Leads, lanes
RAZREZHENNI LYOD	Thinned out ice
RABOTA MASHINI VRAZDRAI	Engines work in different directions; 1 ahead, 2 astern & reverse
RUL	Rudder
SLABI LYOD	Weak, thin ice
SKULA	Turn of the bow
SHPANGOUT	Frame, rib
SYOMNIYE LOPASTI	Removable blades
STROP	Strap
SHLAG	Turn of rope
SHUBA	Additional (outside) protective sheathing for reinforcing the hull of a ship for work in ice
SZHATIYE	Pressure of ice
SPLOCHENNI LYOD	Close Ice
SLABINA	Weak spot in the ice
TVAZHELI LYOD	Heavy thick ice
TOROSI, TOTOSISTI, or TOROSHENNI ICE	Hummocks or hummocky ice
VMYATINA	Indentation
VINT	Propeller, screw
YAKORNI KLYUZ	Anchor hawse pipe
"ZASTRYAL"	"I am stuck in the ice"